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EXPERIENCING AN INFORMAL DINING ROUTE THROUGH THE 3D SCANNED DATA OF URBAN FABRIC

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ABSTRACT

The purpose of this research is to record urban fabric under a municipal scale from the viewpoint of people's traditional dining route in Taipei, Taiwan. The study is conducted from an urban scale to a detail level. The 3D scan data have been collected and carefully integrated for the most effective illustration of issues. Experiencing an informal dining route through the 3D scanned data of urban fabric has led to the creation of a new fabric definition in terms of combining building enclosures and flexible part of fabric. The scan data are the most updated digital reference for urban fabric study. A new application paradigm of 3D scan data is proofed to be useful in illustrating urban activity which is closely related to daily life. The connection between virtual world and real world has also been created.

KEYWORDS: 3D Scan, Point Cloud, Urban Fabric

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Original Article

INTRODUCTION

The purpose of this research is to record urban fabric under a municipal scale based on the experience of people's traditional dining route. This is part of a series of study effort in scanning Taipei urban environments, which are closely related to people's daily living experiences. The scans were conducted at downtown areas (Figure 1) including streets and open spaces.

The former has a mixed use of office buildings and residential apartments; and the latter includes a plaza in front of a temple for leisure and informal dining.

In order to comprehend the behavior, the connection between urban scale and shop scale has to be established. The urban fabrics, as a summation of urban artifact configuration, usually feature consistent appearance and structure for years under a space framework that can achieve, and interpret the cross-relationship and identity between buildings and street block [6, 11].

The representation of urban fabrics requires as-built data to verify the relationship between space and behavior. In order to capture realistic data from streets, the concept of virtual cities [2] should be promoted to include as-built city data to reflect the real content of an environment. Virtual 3D city models are becoming more widely implemented by governments and city planning services [10,14]; this requires highly detailed 3D models that reflect the complexity of city objects and their interrelations.

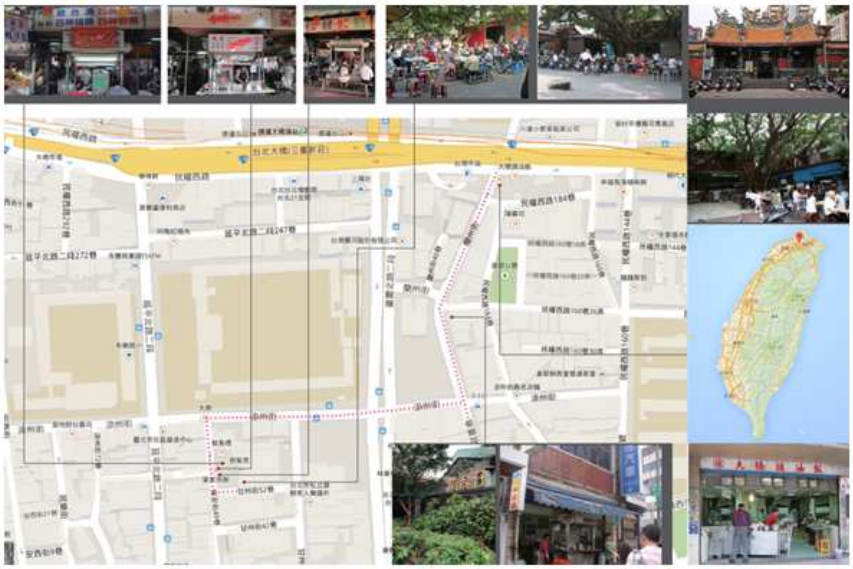

Figure 1: The Scan Path (In Red Dots) and Local Famous Sightseeing Locations

The data from all platforms need to be exchangeable for the best description of an environment [1, 12]. Traditional 2D drawings are no longer sufficient. The technical- and policy-related barriers must be excluded from the institutional points of view [9], so the data cross different ownership can be retrieved. Nowadays, city modeling has reached a new standard in which 3D point cloud models have been treated with rich geometric properties and rich details, which enable the clouds to be integrated with other city model types [13]. Since the cloud models are as-built data, the integration with old environmental data leads to a specific application in showing the most current status of the environment or in contrasting the changes.

Traditional 2D drawings or 3D Digital Terrain Models (DTM) are used for the fundamental reference of spatial structures. To think outside the rigid spatial-temporal framework, scan models should be taken and should be used to illustrate the development of urban models. GIS technology is very helpful in the cognition and interpretation of the urban fabric status [15]. Now Unmanned Aerial Vehicles (UAVs) or aerial LIDAR (Light Detection and Ranging) can add a more detailed description of as-built geometric information with different levels of accuracy. The vast amount of data actually opens up opportunities in various fields of study [12], especially when showing the complexity of city objects and their interrelations [7].

A 3D Scan Approach

The dining activities mainly occur inside and outside the plaza in front of a temple (Figure 2). This plaza is among a series of locations on different streets. The scan path (Figure 1) is purposely planned to connect local famous food booths. The final 3D scanned point cloud model (Figure 3) is registered accordingly.

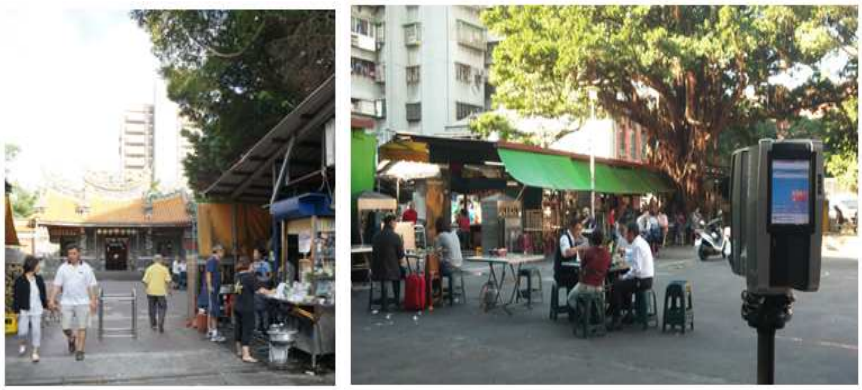

Figure 2: The Dining Activity in Temple Front Plaza and the Scan Process

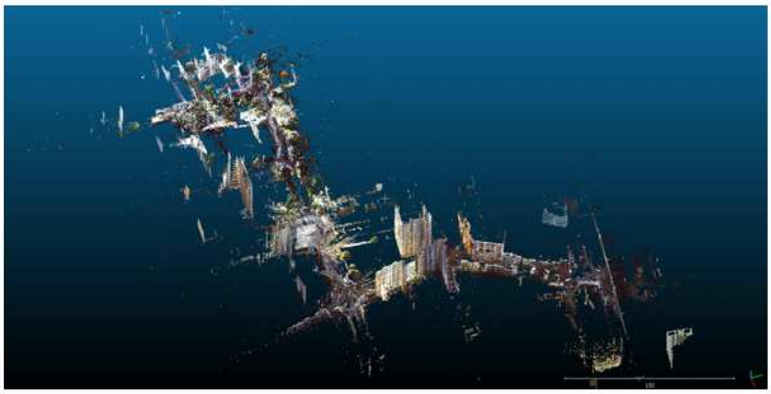

Figure 3: The Scanned 3D Point Cloud Model

The scan of downtown area has enabled the discovery of urban fabric under a different representation.

- **Contrasting Skyline:** tall buildings with huge mass vs. low residential apartments with sophisticated façade signage system (Figure 4). Skyline represents a typical urban identity. The configuration is used for scan registration [8] and visual impact simulations [3]. The contrast shows the vocabularies of repetitive pattern of tall buildings and the faded building volume covered by customer-made artifacts like advertisement panels and roof additions. Skyline of different orientations can be derived by rotating the point model or boxing specific region for best display. The skyline in contrasting configuration indicates the co-existence of new and old urban renewal stages, not just in an urban scale, but also in a micro-view of local development.

- **Temple Front**: a perfect combination of open space and the people's daily need of food and religion (Figure 4). An urban oasis is created as tradition temple design always leaves an open space in front. The plaza, like a community center, serves multiple purposes like religious ceremony and entertainment. In this case, part of the space is occupied by food booths with tables and chairs. The scanned data include the furniture, landscape, visitors, pavements, and service truck in great details.

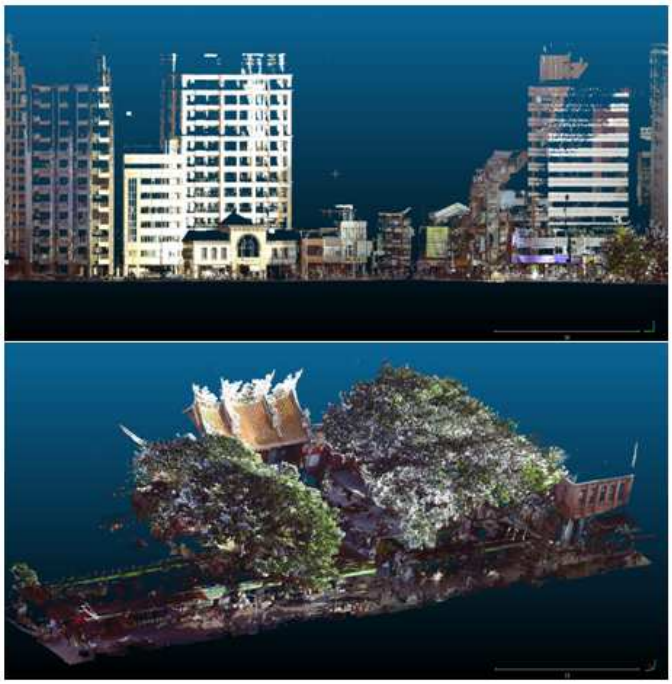

Figure 4: The Skyline and Temple Front Represented in 3D Point Cloud Model

- **Food Booth:** A 3D scan can illustrate the food picture, price, and the shop name in great detail (Figure 5). The signage, public image, and the relation to street are clearly presented in the 3D model.
- **Old House Remodeling:** A fast and useful approach is the photogrammetry modeling of building façade by just using a few pictures. The model clearly shows the vocabulary of opening patterns and the new interpretation of materials (Figure 6).

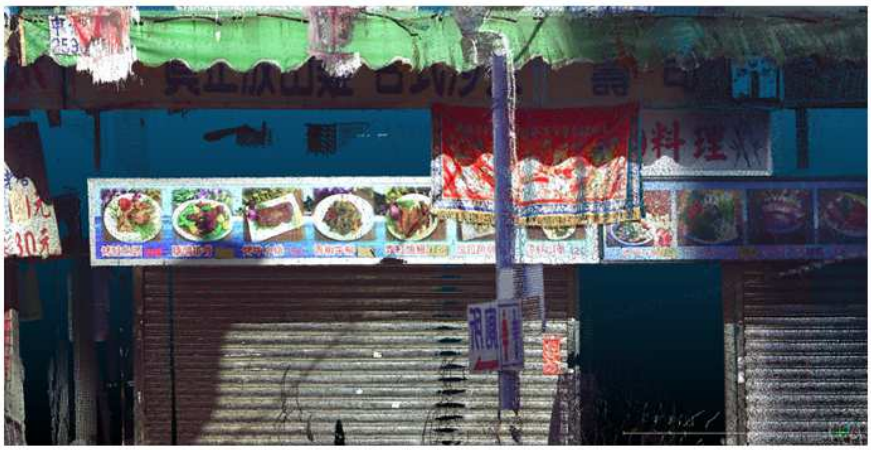

Figure 5: The Detail of 3D Point Cloud Model

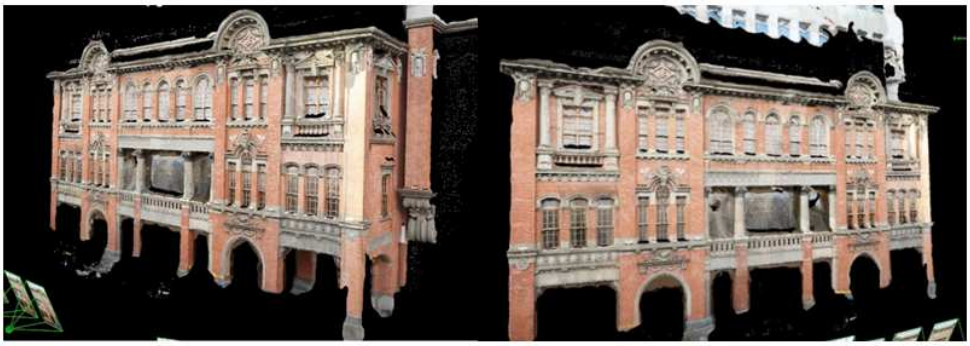

Figure 6: The Remodeled Building Façade Created by Photogrammetry Technology

Connecting 3D Scan with the Behavior in Open Space

The route has an informal dining theme. 3D scan with the behavior in open space has created a new space-traversal experience which connects temple front and associated behavior, dining behavior and open space.

- A **New Space-Traversal Experience:** This is an integration of dining and spatial experiences. Dining experience and open space are usually closely related. The study originated from an attempt to verify an urban fabric through a dining report from a local magazine [5]. The experience was introduced by a gourmet from the view pint of local people, and the food booths were presented by a series of connected nodes (Figure 1). A tourist or people new to this place can visit the old street with dining booths one by one. The experience is also introduced and promoted by government [4].
- **Temple Front and Associated Behavior:** Temple front is a traditional open space to gather people for various local activities like ceremony in a festival or leisure space in a normal day. As a religious center of local people, the Chisan Temple is very famous for its history since 1914. The open space associated activities vary from the morning to the evening, based on when the booth starts deployment.
- **Dining Behavior and Open Space:** In addition to the temple front, a street is also a type of open space. The former mentioned dining experience is also extended to the street in front with a series of food booths. The interaction between the open space and booth front features different pattern from the one inside the temple front with less defined boundary.

DISCUSSIONS

Experiencing a space form a magazine reporter's viewpoint is similar and yet different from the viewpoint of reality. The magazine report acts like a search index. Although photos are usually provided with annotations, the experience can be quite different after being there. For those people visiting there may not have the time or opportunity to go through the introduced trail to explore all kind of food selections in one day. While people usually try to verify what the report said by being in the reality, the closest thing to real world is the virtual environment that help people familiar with a place from a distance.

People perceive a space with different emphasis. So the virtual reality that serves the purpose better comes with the type of illustration which is closely related to how people is involved. This is where this study starts from by focusing the as-built environment and applying a 3D scanner to capture the spatial data that associated with human behavior.

The advantage is to recognize a space or a location at the first sight, and the data are precise enough for measurements in a 1:1 scale.

In addition to the buildings, the scan data also include the people who use the spaces and the objects that associated with the behavior of transportation like motorcycles or trucks. The subjects are very helpful to associated with acts and behaviors that refer to the interaction between urban setting and users. As a result, all the scanned details are retained without any noise discarded. The noise in a scan usually comes from the interference of pedestrians or vehicles and is made of the objects other than the target. Now the scan not only is building configuration specific, but also a perfect tool in observing human behavior and relating an activity to space settings.

The New Urban Fabric

The scan data has created a new fabric definition in terms of following items:

- **Building Enclosures:** The configuration of the original design and remodeled parts were captured with the most updated form.
- **Plans:** The artifact or remodeling, that has modified original design, creates different 2D projection.
- **Skyline:** A new skyline is redefined with additions to roof.
- **Building Envelope-Related Artifacts:** The advertisement panels of various shapes and contents are added to building facades.
- **Flexible Part of Fabric:** The dining areas that associated deployment, re-collected booth furniture, and street side parking were captured and evidenced the fuzzy boundary of urban fabric.

Scan-Related Hardware and Software System

This study extended the size and the complexity of 3D scan to an urban environment by using a Faro Focus 3D® laser scanner. With a range of 80-120m, a street about 700 meter long was retrieve. The result is a set of cloud models of about 0.5 billion points. To view the model, other than by the scanner's host platform, the data was exported under different resolutions to Scenet®, 3D Reshaper®, Meshlab®, CloudCompare®, and Geomagic Studio® for registration and visualization purpose.

CONCLUSIONS

To support a study from an urban scale to a detail level, the data have to be collected and carefully integrated for the most effective illustration of issues. Experiencing an informal dining route through the 3D scanned data of urban fabric has led to the creation of a new fabric definition in terms of building enclosures and flexible part of fabric. The scan data can be used as the most updated digital reference for urban fabric study. Most important of all, a new application paradigm of 3D scan data is proofed to be useful in illustrating urban activity which is closely related to daily life, not just the 2D drawings or GIS data. The connection between virtual world and real world has never been closer.

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